# Data Center

Data Center and Networking

“From the Edge to the Cloud”

# Our Mission

At nVent, we believe that safer systems ensure a more secure world. We connect and protect our customers with inventive electrical solutions.

# nVent Financial Overview

## Company Characteristics

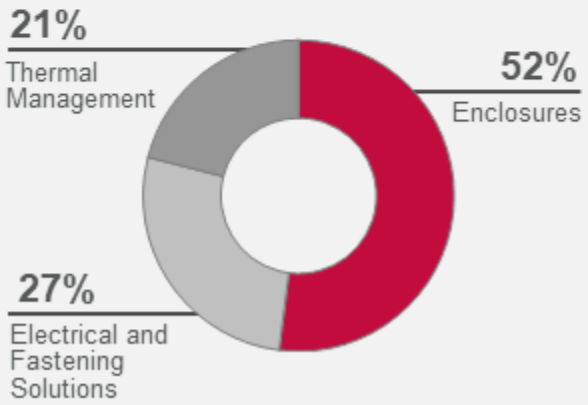
- Leader in **connection and protection**
- Industry **leading positions and strong brands**
- Attractive **margin profile**
- Strong **free cash flow** generation
- **10,000+ employees** worldwide

## 2022 Financials

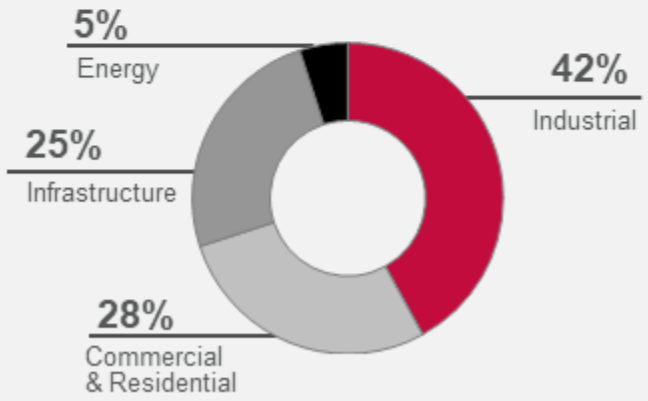
**$2.9B**

Revenues

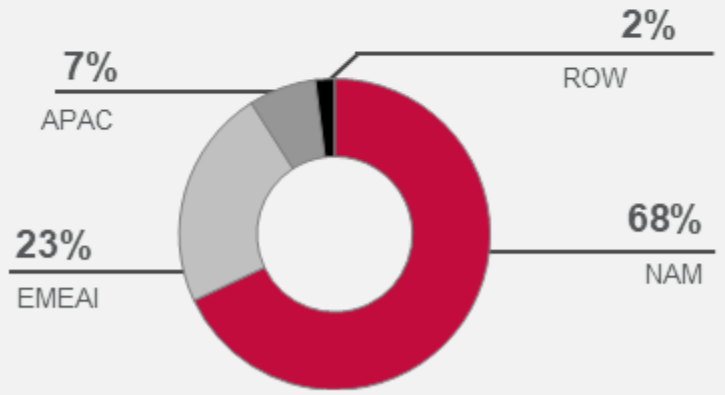
## Segments




## Verticals




## Geographies




**High performance electrical company focused on connection and protection**

Segment, verticals and geographies charts by revenue

# Building a More Sustainable and Electrified World

https://www.nvent.com/en-us/about-nvent/ESG


## Investing in **Sustainability and Electrification**

- **New Products:** by 2025 90% of our new product funnel will have positive ESG impact
- **Acquisitions:** expanding our portfolio with electrification trends, $300M in sales in 2022

## Strong Customer **Value Propositions**

- Energy efficiency
- Resiliency and protection
- Time savings and labor savings
- Safety
- Product lifespan and serviceability
- Eco-friendly

## Highlighted Sustainable and Electrified **Value Propositions**

**Liquid Cooling**
*Energy efficiency*

**40-60%**
reduction in power consumed using precision liquid cooling versus typical air-cooled installations

**Advanced Electrical Connection Systems**
*Time savings*

**50%**
faster installation*

**20%**
reduction in total installed cost*

**Electrical Fastening**
*Time savings*

Prefabricated solutions are safer for installation, require fewer tools and reduce installation time

**Hot Water Maintenance**
*Energy efficiency*

**16%**
energy savings using electric heat trace for pipes for instant hot water versus recirculation systems

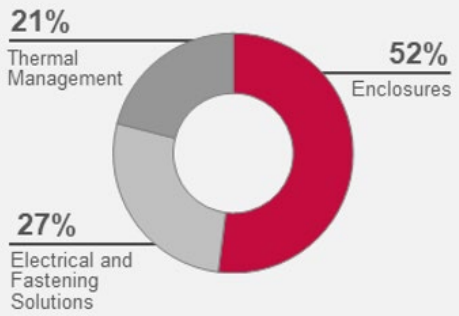
**Sustainability and electrification are core to our business strategy**

Sources: Based on nVent Internal Estimates and PG&E Commercial Service Water Heating Applications 2015

*Compared to traditional cable alternatives

# Fast Facts About nVent

**Segments**




## ENCLOSURES

enLOGIC by nVent

nVent HOFFMAN

nVent SCHROFF

## THERMAL MANAGEMENT

nVent RAYCHEM

nVent TRACER

## ELECTRICAL AND FASTENING SOLUTIONS

nVent CADDY

nVent ERICO

nVent ERIFLEX

**As the world becomes more electrified, this creates more demand and more need for what we do**





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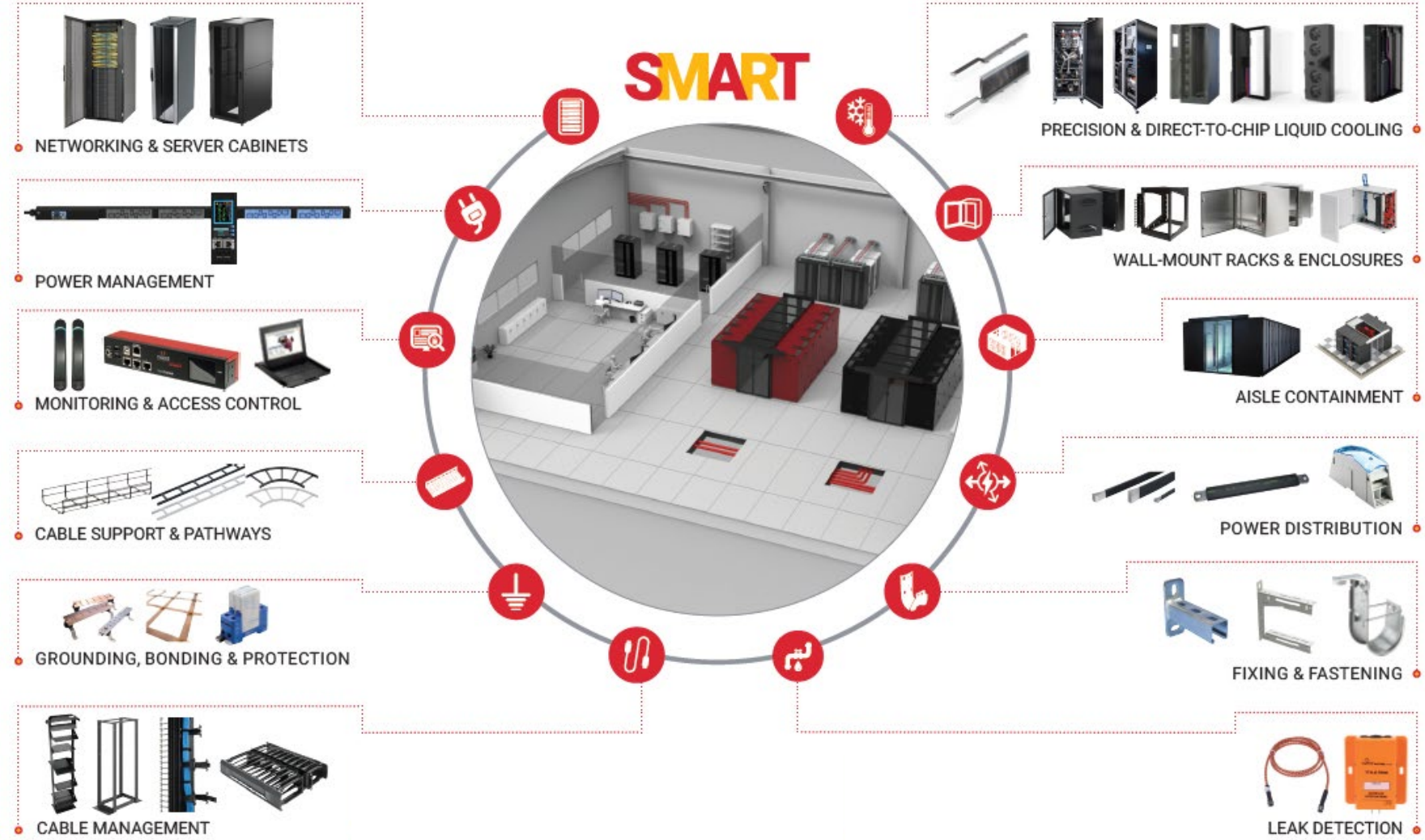
# NEXT GENERATION DATA CENTER INNOVATION FOR A CONNECTED WORLD




**Our flexible modular portfolio, combined with design and project support, enables you to specify and deploy your project on time to ensure data and network infrastructure availability and protection.**

# Data Center Cooling

Datakeskusten uudet jäähdytysteknologiat

# What's happening?

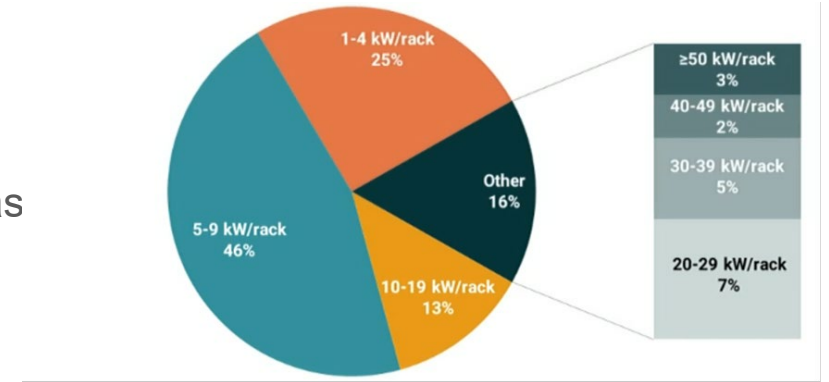
**UPTIME** → POWER / COOLING IS KEY FOR AVAILABILITY OF IT EQUIPMENT.

**CAPEX vs OPEX**

- Energy consumption and TCO perspective

## DENSITY

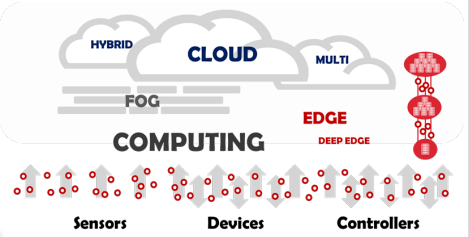
- The average density per rack was rising from 2.4kw by 6kW in the last 9 years.
- Chip power roadmap shows majority of chip power will be increasing pas the limit of air cooling within the next 24 months - Market size for liquid-based cooling techniques to grow from $1.5B in 2020 to $6.5B in 2027
- More compute power housed in less real estate




*Source: Uptime Institute Global Survey of IT and Data Center Managers 2020, n=422*

## DOWNLOAD VS UPLOAD WORLD

- Decentral installations challenge the designers and operators
- "By 2025, 75% of enterprise-generated data will be created and processed outside a traditional centralized data center or cloud" *Gardner*




## SUSTAINABILITY

Net Zero programs and Water usage restrictions, ESG targets

# Cooling Product Overview


Server Rack


Server Rack w/Fans


Server Rack w/AC


Row Aisle Containment (Passive)


Row Aisle Containment (Active w/IRC)

# COOL THE SERVER, NOT THE ROOM

## AIR AND LIQUID COOLING SOLUTIONS

Chassis Level Immersion Cooling


Row and Rack Coolant Distribution Unit (CDU) & Rack Manifolds


Rear Door Cooling (Passive/Active)


In Row Cooling – LX


Rack w/Integrated LX Cooling (MicroEdge)


<40°C — Increasing water inlet temperatures – Opportunity for free cooling — <18°C

**EDGE AND WHITESPACE COOLING SOLUTIONS**



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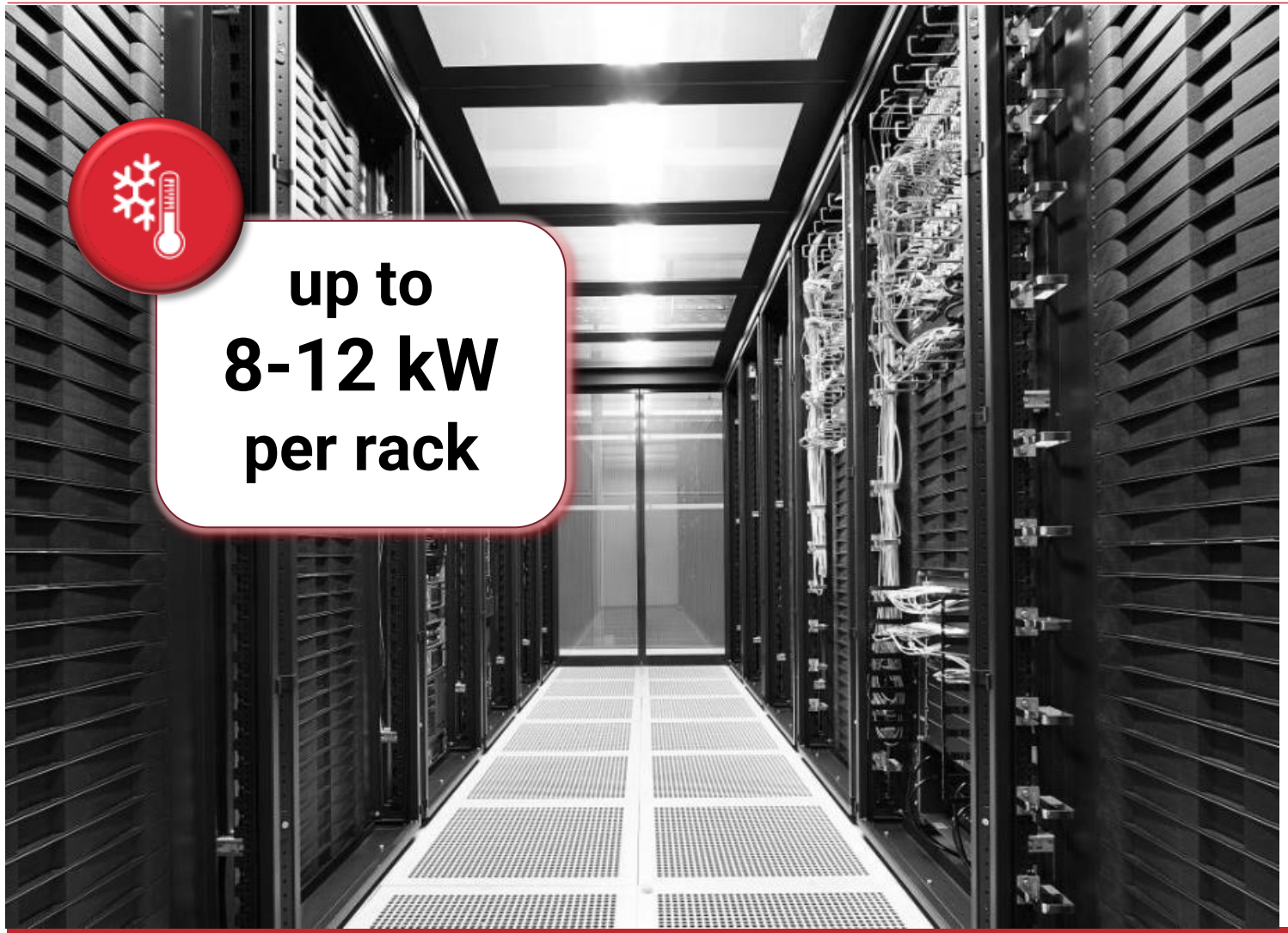
# “traditional” Cooling

- Containment
- Side Cooler
- Rear Door Cooler

# Containment

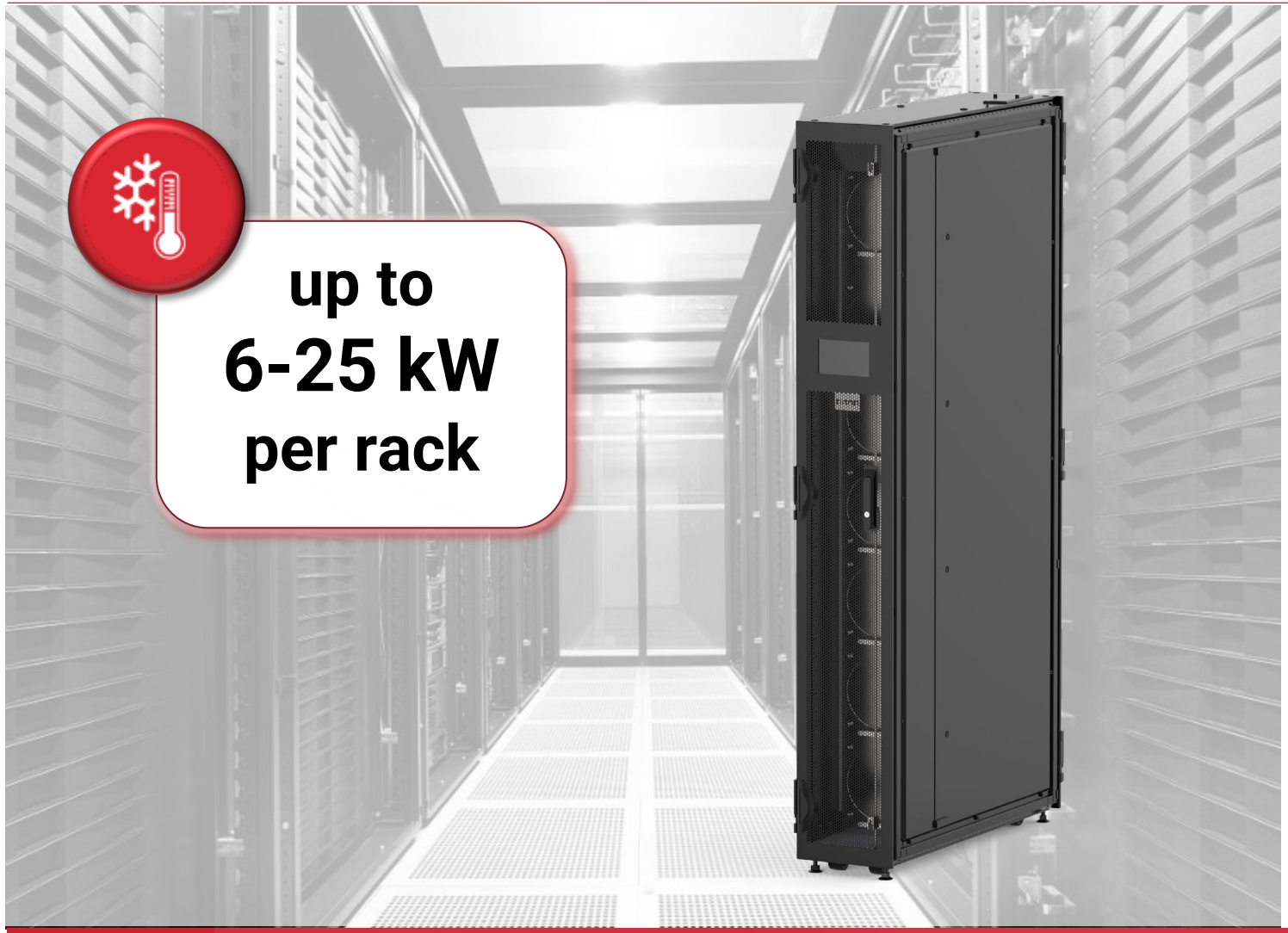



- State of the art
- Proven technology
- Availability of components

- Return air temperature <35°C
- Water inlet n/a
- High airflow required
  (10 m³/h per kW → 100m³/h @10kW)

**Room based Cooling Solution**

# Containment with InRow Cooling




- State of the art
- Proven technology
- Availability of components
- Planning / Redundancies
- No raised floor mandatory

- Return air temperature <45°C
- Water inlet <20°C
- Efficient regulation

**Aisle based Cooling Solution**

# RackChiller 300mm Cooler Technical Specifications

## GENERAL SPECIFICATION

| | |
|---|---|
| Height | 42U (2000mm) |
| Width | 300mm |
| Depth | 1000mm / 1200mm |
| Power Requirement | 230V |
| Communication Interfaces | Modbus RTU, Modbus TCP, SNMP, Redfish, Web Browser |

## FANS

| | |
|---|---|
| Hot swap fan modules | 7 fans |
| Air flow (100%) | 6700 m³/hr |
| Fan shutters for back-flow prevention | |
| Differential pressure controlled | |

## COOLING PERFORMANCE

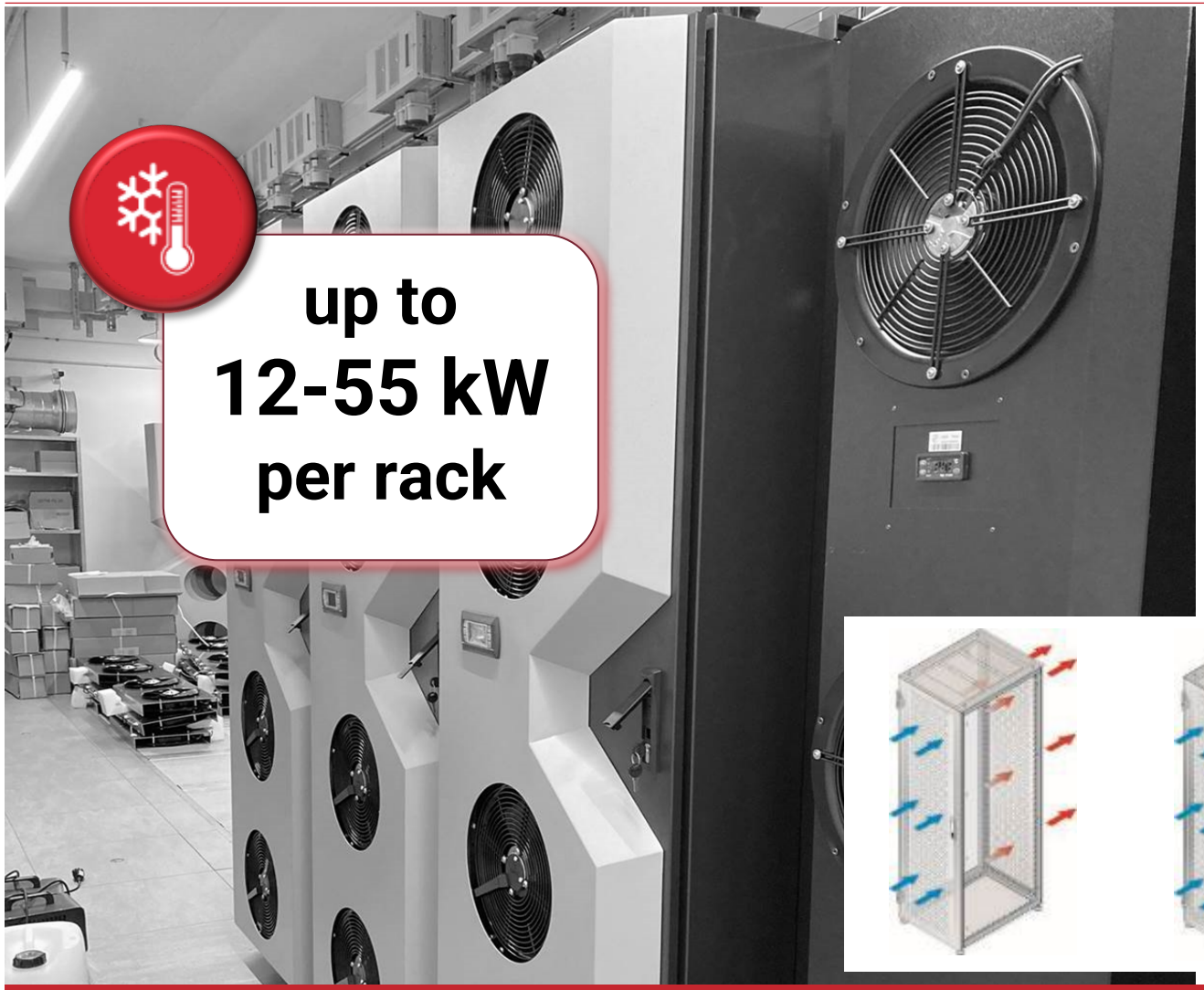
Air 6.700 m³/h – Water 100 lpm

Pressure drop liquid 158kPa

Power consumption 2543W

| **Performance** | **48kW** | **36,9kW** |
|---|---|---|
| Air in [°C] | 45 | 45 |
| Air out [°C] | 22,3 | 27,3 |
| Delta T air [°C] | 22,7 | 17,7 |
| Liquid in [°C] | 14 | 20 |
| Liquid out [°C] | 20,9 | 25,3 |
| Delta T liquid [°C] | 6,9 | 5,3 |

# Rear Door Cooler






- State of the art (?)
- Proven technology (?)
- Availability of components
- Planning / Redundancies
- No raised floor mandatory
- Can be operated fan less

- Return air temperature <50°C
- Water inlet <22°C
- Efficient regulation

**Rack based Cooling Solution**



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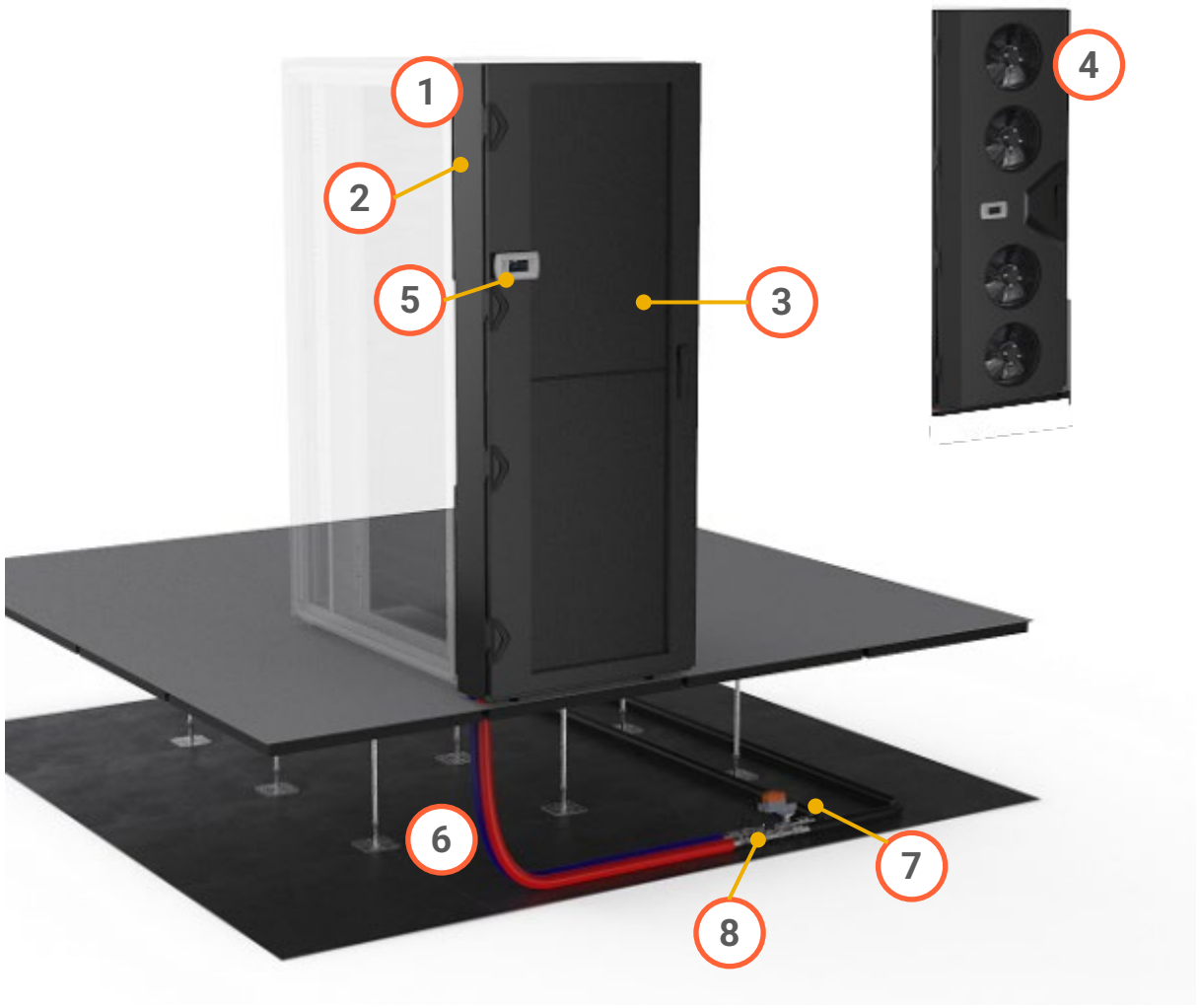
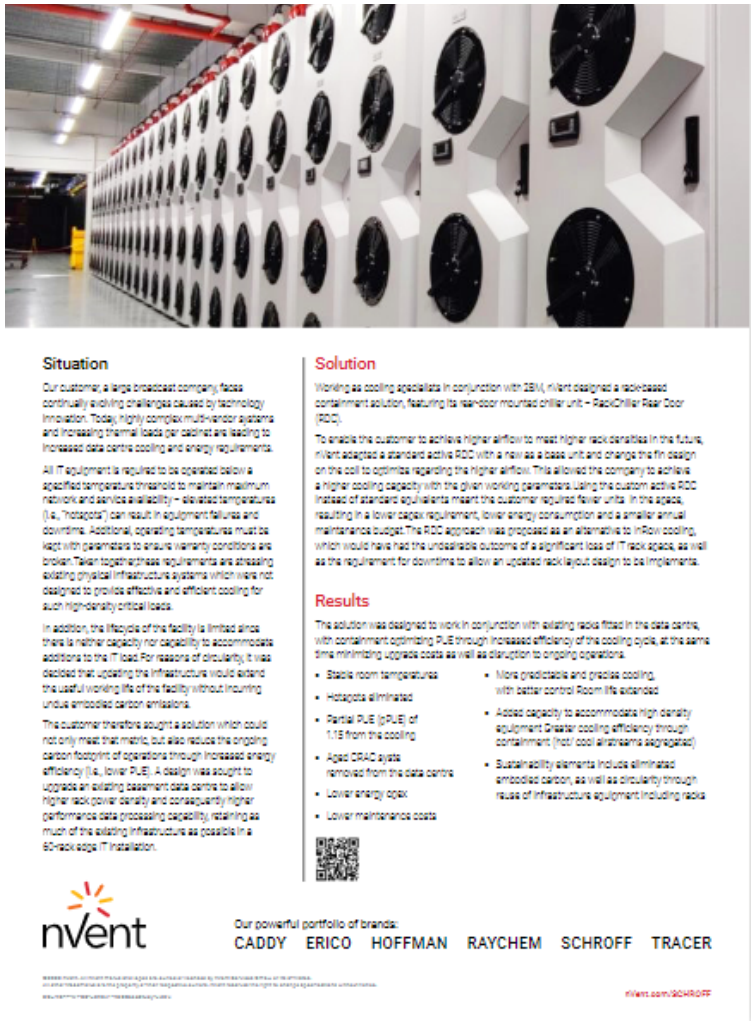
# RackChiller Rear Door - Layout




1. Mounting frame
2. Optional integrated Controller
   (SNMP and Modbus interface)
3. Temperature Sensor
4. Active fan solution
   with integrated air
   differential pressure sensor

5. Optional display
6. Optional flexible water hoses
7. Optional valve and actuator
8. Optional water sensor kit
   (flow / pressure / temperature)

# New Case Study RDC


- 65 active RDCs Racks 47RU x 800W
- Assembled at 3rd party cabinets – max 16kW
  - Room Temp approach 24°C
  - Water Supply Temperature 18°C

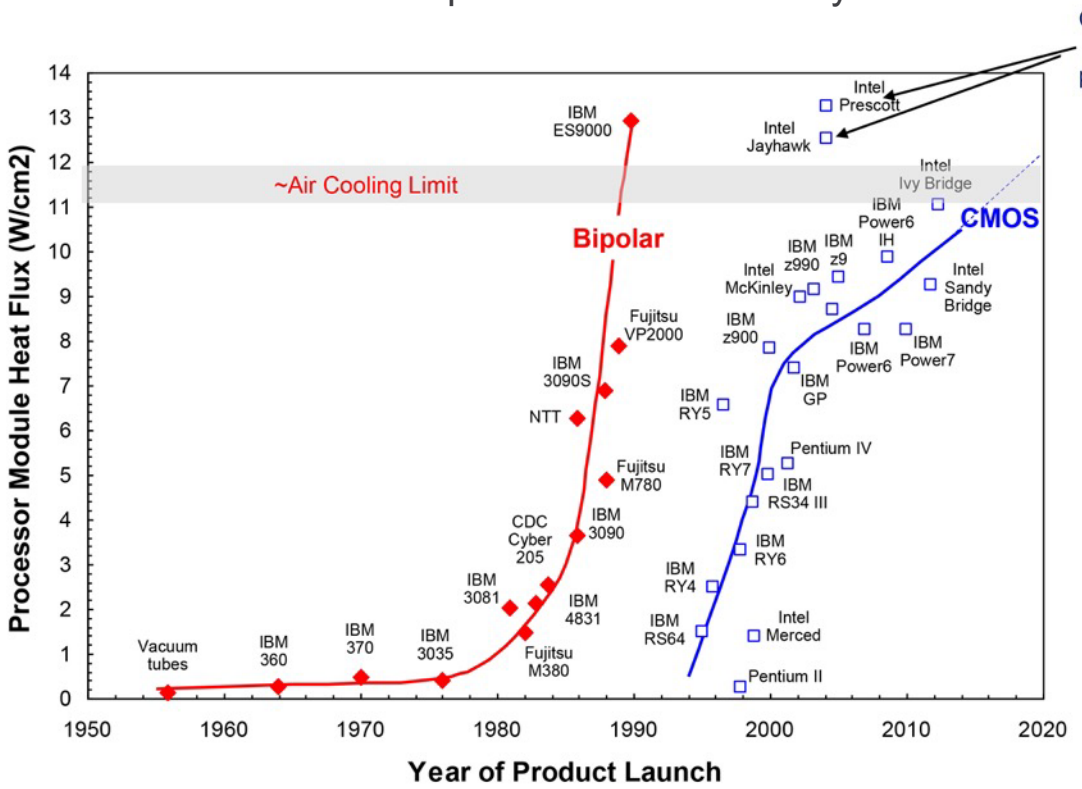
# LIQUID COOLING ARCHITECTURES

- Direct to Chip
- Chassis Immersion

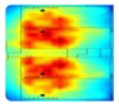
# Why liquid cooling?

- **System Level**
  - CPU/GPU/Accelerator TDP (thermal design power) exceeding air cooling limits
  - Latency issues driving ultra-dense layouts squeezing critical cooling volume
  - Air cooled solutions budgeting up to 20% energy at server level
- **Room Level**
  - Rack power trends regularly exceeding 20kW in all market segments (~8-12kW capacity typical)
  - Airflow limitations being exceeded at rack level
- **Environmental**
  - Energy Consumption
  - Water Consumption
  - CO2 Emissions
  - Location Availability
  - Critical IT Protection

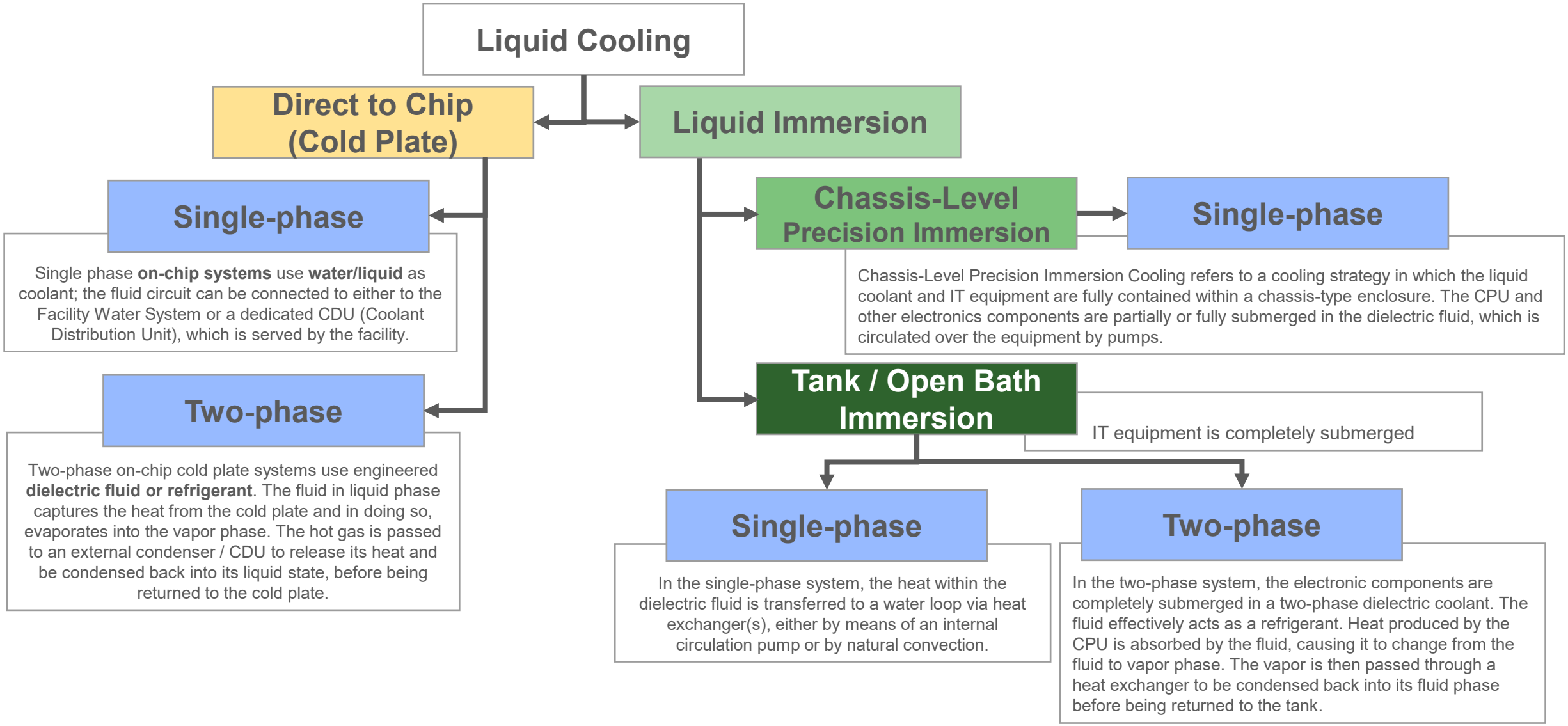
Evolution of processor heat density



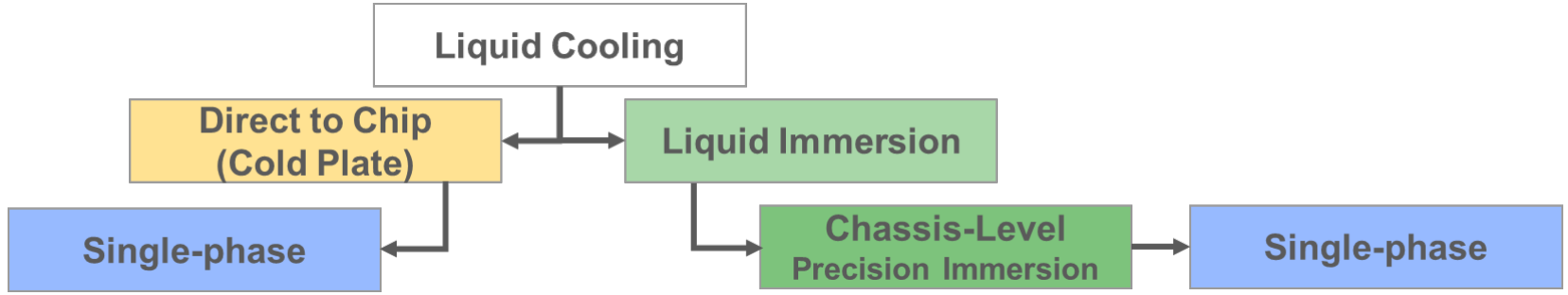

*Heat Flux* – *heat generated per unit area*



# Five main liquid cooling architectures



# nVent Liquid Cooling

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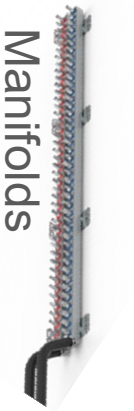
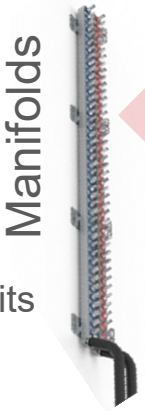
**Infrastructure for Direct to Chip and Chassis-Level Immersion Cooling**

Equipment with Cold Plates




- Coolant Distribution Units, Liquid to Air Heat exchanger with Reservoir and Pumping Units
- Rear Door and Row Air to Water Heat-Exchanger
- Racks, PDUs and Monitoring




Immersion Chassis

Facility Water / Cooling System



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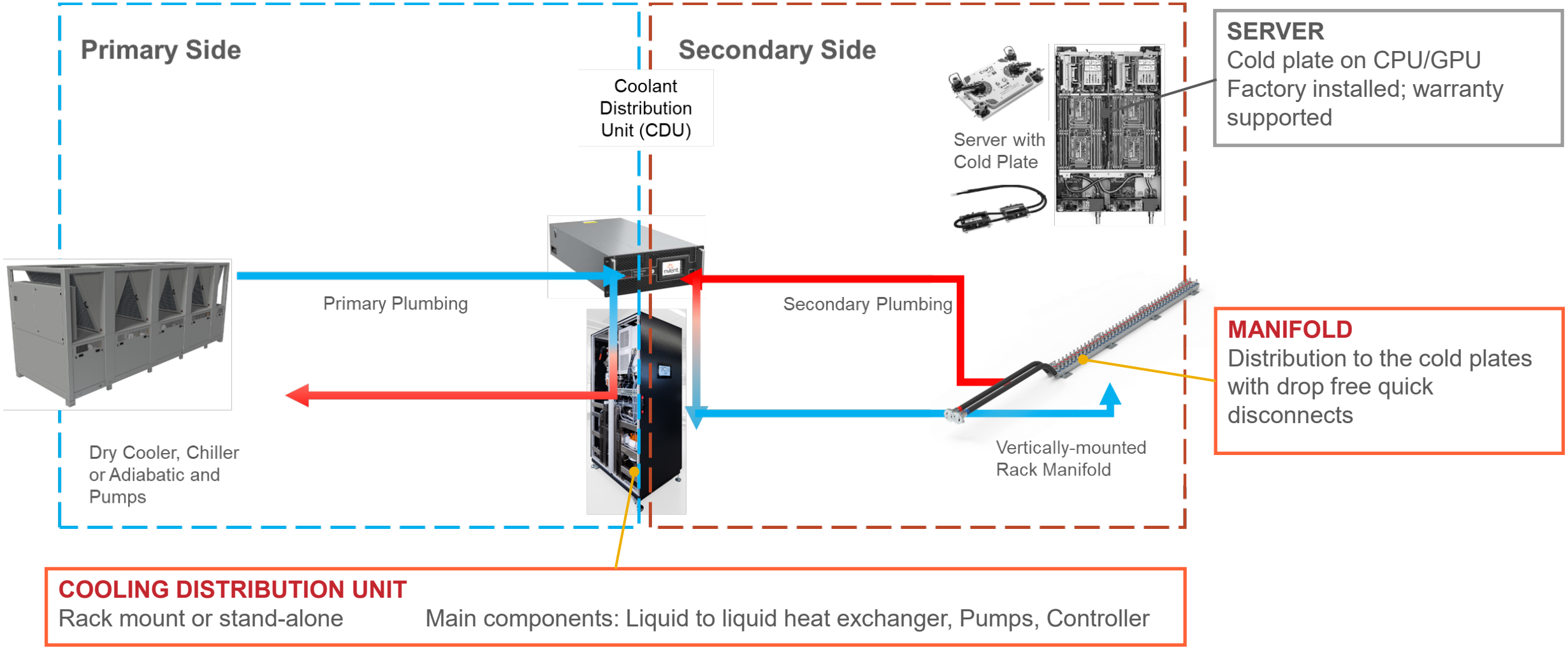
# DIRECT TO CHIP COOLING LAYOUT



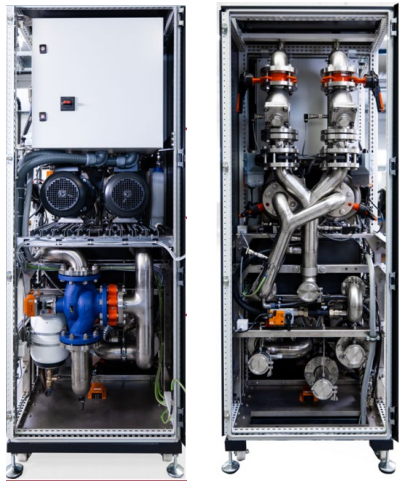

**SERVER**
Cold plate on CPU/GPU
Factory installed; warranty supported

**MANIFOLD**
Distribution to the cold plates with drop free quick disconnects

**COOLING DISTRIBUTION UNIT**
Rack mount or stand-alone Main components: Liquid to liquid heat exchanger, Pumps, Controller

# Design Options

Rack Mount CDUs to Support
1 – 3 racks with Direct to Chip cooled equipment.

Stand alone CDU to support several racks with Direct to Chip cooled equipment.

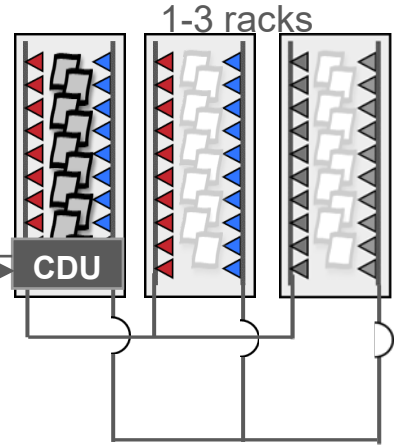
Manifolds

Cold Plates

1-3 racks

Primary facility side

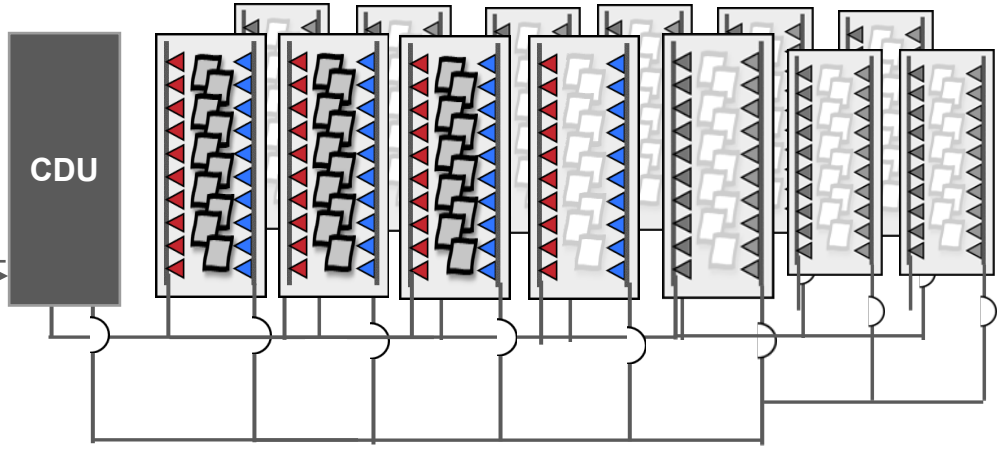
CDU



several racks

Primary facility side

CDU





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# DIRECT TO CHIP (HYBRID) COOLING SOLUTION LAYOUT

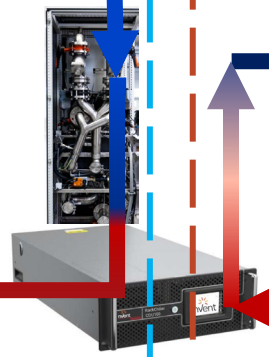
- Cold Plates do not capture 100% of the heat with liquid.
- Setup an air loop with CRAC, InRow or Rear Door cooler
- Water circuits can be optimized in regards to temperatures

Air Loop

Primary Side

Secondary Side

Primary (Facility) Plumbing



Secondary (Internal) Plumbing

Coolant Distribution Unit (CDU)

Vertically-mounted Rack Manifold

Dry Cooler, Chiller or Adiabatic and Pumps



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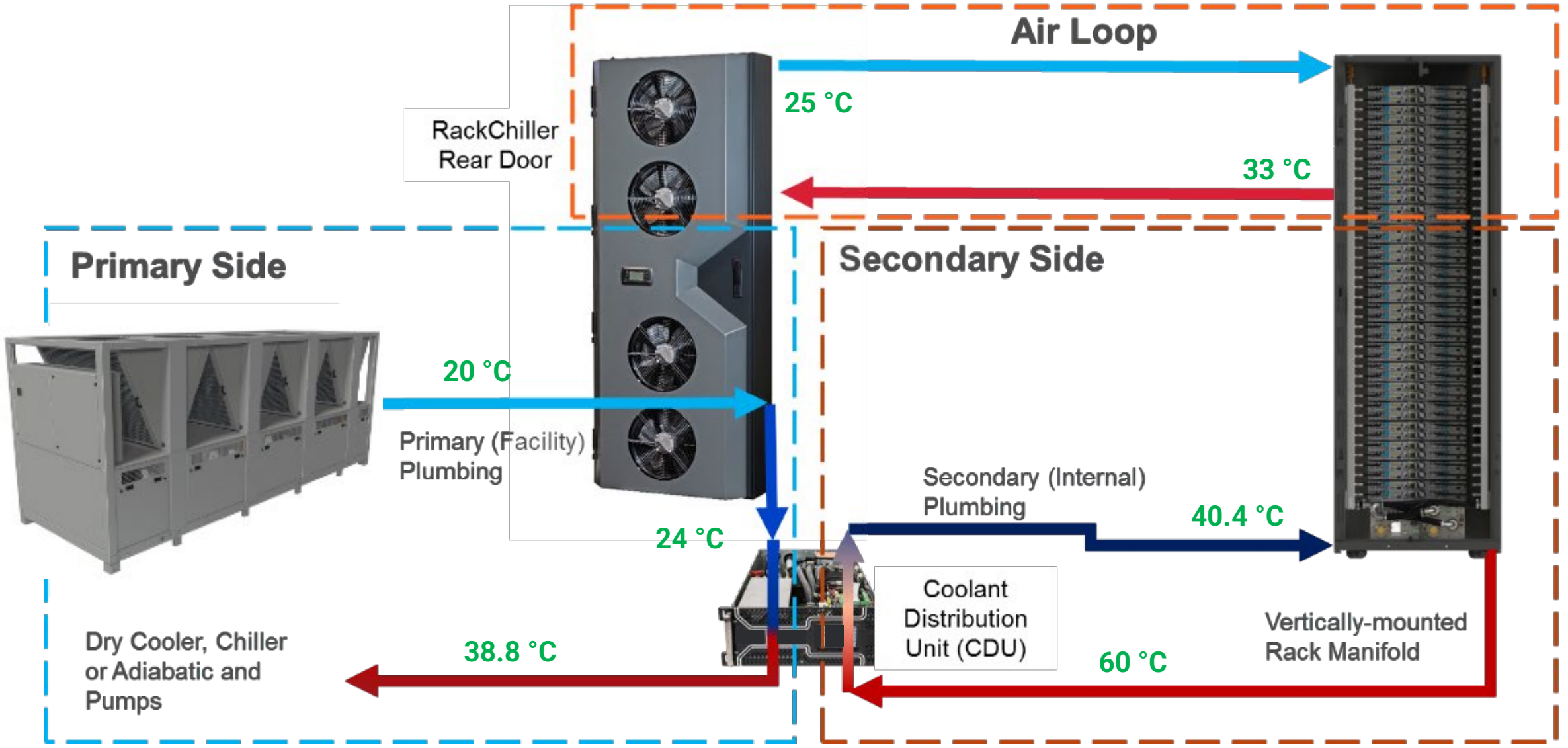
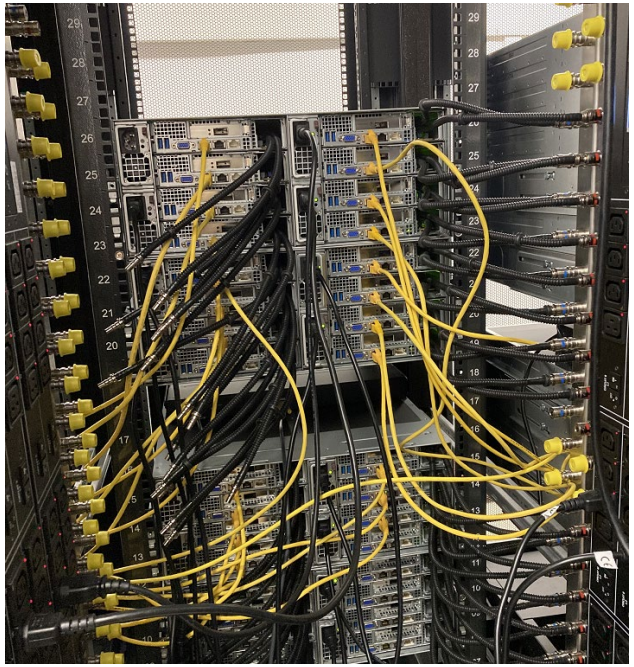
# Hybrid Cooling Layouts with Temperatures



# Direct to Chip Hybrid Cooling Installation

- 9 Racks 47RU x 800W x 1400D
- Passive RDCs
- 4x 63Amp 3P PDUs each rack
- 2 Manifolds (42 connections) to support 2 cold plates at 42RU
- 2 standalone CDUs in Technical Room

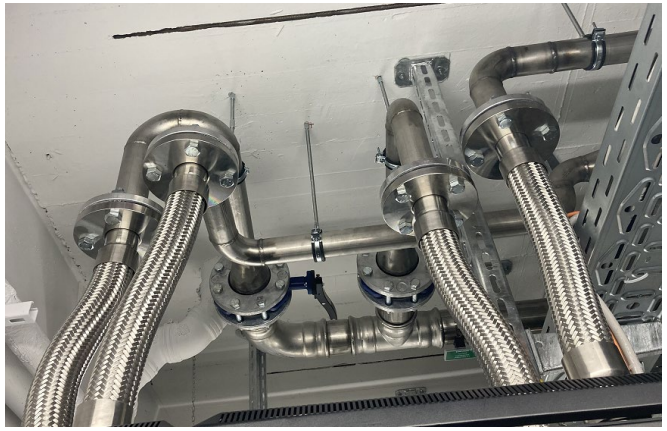


**FRONT**

**REAR**

**INSIDE REAR**

**TECNICAL ROOM**





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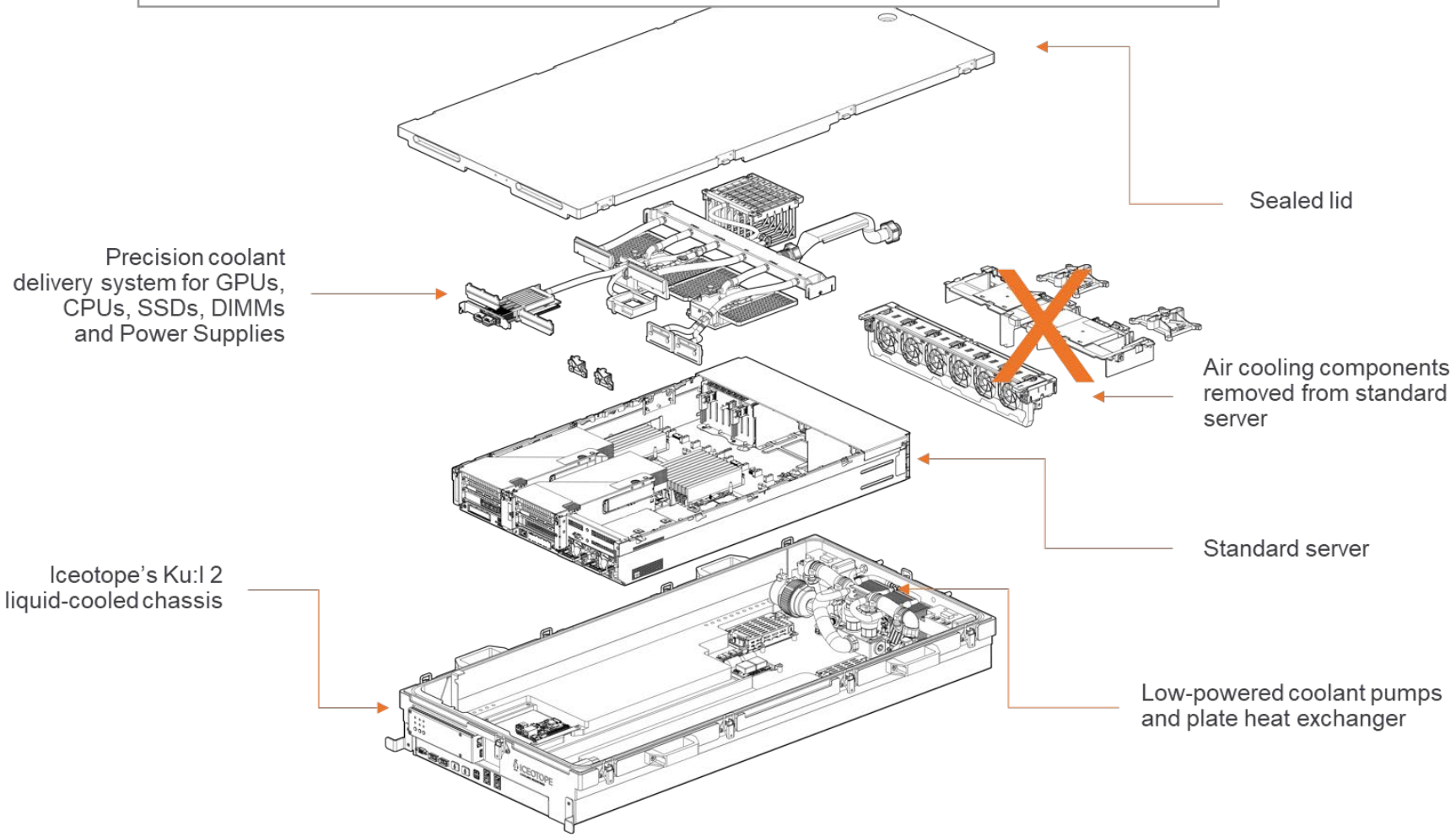
# Chassis Level Immersion

Next step to increase % heat captured by liquid close to 100%

## What is it?

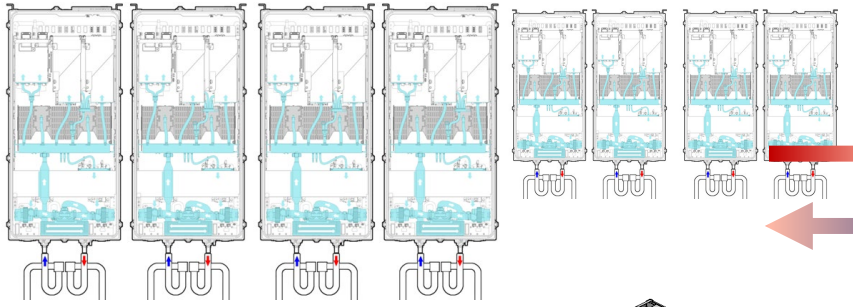


# How it works at chassis/rack/facility level

Coolant Distribution Unit (CDU)

Liquid to Air Unit (LTA)

## Chassis Level Immersion Cooling



47 °C

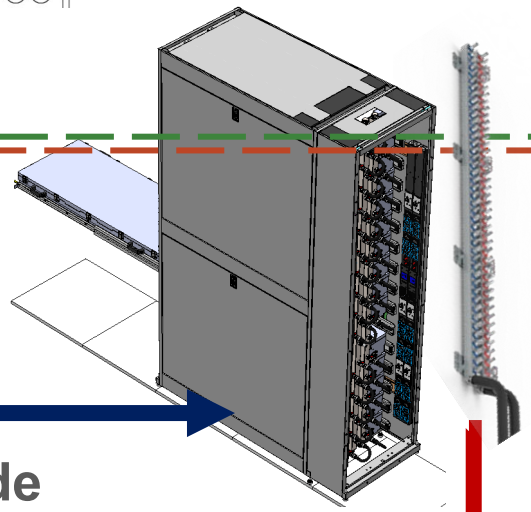
40 °C

## Primary Side

Primary (Facility) Plumbing

33 °C

38 °C



## Secondary Side

Secondary (Internal) Plumbing

Vertically-mounted Rack Manifold

Dry Cooler, Chiller

40 °C

45 °C



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# nVent Data Solutions

Work with experts to get the best fitting solution